

**WHAT IS CLAIMED IS:**

1. A method for hole-filling in 3D models, comprising  
the steps of:
  - identifying vertices adjacent to hole boundaries in a  
5 mesh of points on a digital image;
  - constructing a signed distance function based on  
vertices adjacent to hole boundaries;
  - fitting a Radial Basis Function based on the  
constructed signed distance function;
  - 10 evaluating the fitted Radial Basis Function on a grid  
including the hole; and
  - extracting and meshing the points on the hole surface  
to fill the hole.
- 15 2. The method as recited in claim 1, further  
comprising the step of generating a mesh using points of an  
image.
3. The method as recited in claim 2, further  
20 comprising the step of scanning an image using a Ball  
Pivoting Algorithm.
4. The method as recited in claim 1, further

comprising the step of listing and indexing holes in the mesh.

5           5.    The method as recited in claim 1, further comprising the step of scanning an object to generate the mesh.

10           6.    The method as recited in claim 1, wherein the step of identifying vertices adjacent to hole boundaries includes employing a search algorithm.

            7.    The method as recited in claim 1, wherein the search algorithm includes employing a breadth first search.

15           8.    The method as recited in claim 1, wherein the step of constructing a signed distance function includes:  
            defining a distance function  $d$  for additional points, which lie on surface normals from vertices;  
            evaluating a continuous distance function on a grid.

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            9.    The method as recited in claim 7, wherein a value of a distance  $d$  between each additional point and its associated vertex controls a topology of an output surface,

and further comprising the step of defining the value of distance  $d$  by a user.

5        10. The method as recited in claim 7, wherein a resolution of the grid defines the detail of generated surfaces, and further comprising the step of defining the resolution of the grid by a user.

10       11. The method as recited in claim 1, wherein fitting a Radial Basis Function based on the constructed signed distance function includes solving a set of simultaneous equations given by Equation 6.

15       12. The method as recited in claim 1, wherein the step of extracting is performed by a zero crossing method.

13. A system for hole-filling in 3D models, comprising:  
a storage device, which stores a digital form of an  
20 image;  
a processor, which graphically renders the image on a graphics subsystem;  
the system further comprising a program which

identifies points in the image and integrates a mesh between these points to define vertices adjacent to hole boundaries in the mesh, the program further comprising:

5 a signed distance function which is constructed based on vertices adjacent to hole boundaries;

a Radial Basis Function which is fitted based on the constructed signed distance function, the Radial Basis Function being evaluated on a grid including one of the holes such that the hole is filled by extracting and  
10 meshing the points of the hole surface.

14. The system as recited in claim 13, wherein the mesh is generated using points of an image.

15 15. The system as recited in claim 13, further comprising an image acquisition device, which scans a digital image of an object to be modeled.

16. The system as recited in claim 13, wherein the  
20 program employs a Ball Pivoting Algorithm in scanning an image.

17. The system as recited in claim 13, wherein the

program identifies vertices adjacent to hole boundaries by  
employing a search algorithm.

18. The system as recited in claim 17, wherein the  
5 search algorithm includes a breadth first search.

19. The system as recited in claim 13, wherein the  
signed distance function includes values of distances  
between additional points located on a surface normal from  
10 associated vertices, the values of distances to control a  
topology of an output surface.

20. The system as recited in claim 19, wherein the  
values of distances are user defined.

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21. The system as recited in claim 13, wherein a  
resolution of the grid defines the detail of generated  
surfaces.

22. The system as recited in claim 21, wherein the  
20 resolution of the grid is user defined.

23. The system as recited in claim 13, wherein the

Radial Basis Function includes the form of  $s(x)$  in Equation 4.

24. A program storage device readable by machine,  
5 tangibly embodying a program of instructions executable by the machine to perform method steps for hole-filling in 3D models, the method steps comprising:

identifying vertices adjacent to hole boundaries in a mesh of points on a digital image;

10 constructing a signed distance function based on vertices adjacent to hole boundaries;

fitting a Radial Basis Function based on the constructed signed distance function;

15 evaluating the fitted Radial Basis Function on a grid including one of the holes; and

extracting and meshing the points on the hole surface to fill the hole.

25. The program storage device as recited in claim  
20 24, further comprising the step of generating a mesh using points of an image.

26. The program storage device as recited in claim

24, further comprising the step of listing and indexing holes in the mesh.

27. The program storage device as recited in claim 24, wherein the step of identifying vertices adjacent to hole boundaries includes employing a search algorithm.

28. The program storage device as recited in claim 24, wherein the step of constructing a signed distance function includes:

defining a distance function  $d$  for additional points, which lie on surface normals from vertices;  
evaluating a continuous distance function on a grid.

29. The program storage device as recited in claim 28, wherein a value of a distance  $d$  between each additional point and its associated vertex controls a topology of an output surface, and the value of distance  $d$  is defined by a user.

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30. The program storage device as recited in claim 28, wherein a resolution of the grid defines the detail of generated surfaces, and the resolution of the grid is

defined by a user.

31. The program storage device as recited in claim  
24, wherein fitting a Radial Basis Function based on the  
5 constructed signed distance function includes solving a set  
of simultaneous equations given by Equation 6.